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CONTENTS

	PAGE
Food Management	213
Obituaries:	
Professor R. Cecil Wood	214
Mr. de L. H. A. Corbin	215
New Hebrides	216
Po-yok and Isano Oils	221
Preliminary Tests with DDT against Insect Pests of Food-crops in the Lesser Antilles	222
Soya Beans in Nigeria	226
Review:	
The Energetic Efficiency and Growth of Animals	229
Specialized Fields in Soil Science	230
Average Weight of a Bunch of Bananas	231
Chemical Notes	232
Note Book of Tropical Agriculture	232

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FOOD MANAGEMENT

IN a paper* recently read before the Food Group of the Society of Chemical Industry, London, Mr. Duckham introduces a new term — food management—which he defines as the means by which food resources, in the broadest sense, are used for feeding the family, community, or nation. Bad food management, he says, may result in underfeeding, even in a land of plenty; whereas good food management may result in adequate nutrition from limited food resources. Efficient utilisation of these resources depend on the co-operation of the scientist, the economist, and the sociologist, using the latter term broadly to include the administrator, the educator, the anthropologist and the psychologist. Knowledge gained from scientific research must be the basis for defining man's dietary requirements and the capacity of various combinations of foods to satisfy these requirements: it can also provide the basis for improved technique in the production, processing, and distribution of food so that more and better food reaches the consumer at lower costs. In such research, however, the importance of economic factors and education must not be overlooked.

In a study of conditions in the United Kingdom before and during the war Mr. Duckham shows how poverty is the first cause of hunger and malnutrition. Receiving an income insufficient to cover the cost of a diet that is nutritionally adequate the individual purchases cheap energy foods to satisfy his calorie requirements. These energy foods, such as cereals, sugar and margarine made from vegetable oils, are cheap to produce and easy to transport. They are essentially direct crop products of good storage quality. In contrast, the protective, vitamin and mineral-rich foods are expensive. Milk and its products, meat, fish, eggs, fruits and vegetables are actively respiring plant tissues or recently living animal tissues, of high moisture content and generally, of low keeping quality. For these reasons they are expensive.

Four methods of improving nutrition are suggested: by increasing *real* consumer purchasing power, by reducing the *real* cost of food, by directing consumption to particular foods or

*Duckham, A. N. (1945). Food Management and the Chemist. *Chem. & Ind.* No. 36, pp. 282-284.

economic diets, by improving the nutritive values of common foods. While the first two of these methods are mainly attainable by economic means yet all four are substantially dependent upon scientific progress. Before the war, the first two methods were certainly, and the last two possibly, having beneficial effects. During the war all four methods have been conscientiously used with, on the whole, favourable results. After the transition from war to peace it may be hoped that the first two methods will continue to operate. The announced Government policy of full employment and social security should tend to increase or at least maintain real consumer purchasing power while technical progress in food production, distribution, processing and storage should continue to reduce the real costs of food. Further, the consumer will, one hopes, not forget all he has learnt about food during the war. Lastly, wartime experience in enhancing nutritive values is unlikely to be overlooked.

A simple method of nutritional improvement, although complex from a scientific standpoint, is the development by the plant breeder of foods containing more than average vitamin content. Certain varieties of wheat of recent development (Renown and Regent) are considerably richer in one of the vitamins of the B-complex (aneurin) than the main Canadian commercial variety (Marquis). Again, one variety of New York apple (Northern Spy) contains five times as much ascorbic acid as another. Further, soil, climatic region and weather substantially influence the nutrient content of farm products and may well be at least as important as genetic factors. As man's control over these is limited, however, attention to the genetic and crop management aspects may prove more profitable. In this field, in which the rôle of the chemist is obvious, already much is known, for instance, about the production of eggs and milk of more than average vitamin A content. Thus, research on the improvement of the nutrient contents of food at the time it leaves the farm has considerable potentialities but the value of the results of such research, if and when they are generally applied in practice, should not be dissipated through indifferent marketing, storage and processing methods.

Another method of nutritional improvement, which Mr. Duckham rightly regards as relatively unsafe, is the fortification of foods with synthetic vitamins and minerals. He feels that the approach of producing more nutritious foods and improving processing, marketing and cooking to minimise vitamin destruction will be more effective than efforts made solely in the economic or educational field. It is difficult to convert people from the traditional dietary habits for, as Sherman said " Eating has an immense vogue as an amusement ".

Mr. Duckham's suggestions are of particular interest in view of the many dietary patterns in existence. From polar regions to the tropics and from orient to occident mankind has succeeded in constructing reasonably adequate diets out of a diversity of materials, most of them locally available. The dietary patterns of civilizations have always reflected the pattern of the agriculturally possible. While more diversified agriculture is a valuable goal from many standpoints it is interesting to note that nutritional research is seeking a means of improving human diets which implies minimal changes in cropping systems.

J. Duckworth

OBITUARY

PROFESSOR R. CECIL WOOD, M.A.

It is with deep regret that we have to record the death of Professor R. Cecil Wood at his home in Woodbridge, Suffolk, on 22nd November, 1945. It is only seven years since an appreciation of Professor Wood and of his work appeared in this Journal at the time of his retirement from the College in 1938. When he resigned from the Chair of Agriculture here, Professor Wood was a man apparently still in the prime of life both mentally and physically. He was in years the oldest member of the staff, but in his many active interests, agriculturally, socially and in sports, he set a level of output that many of his younger colleagues were hard put to maintain, much less exceed. He was a progressive thinker, and in his own subject, tropical agriculture, by reading, study, personal contacts and keen interest he became a leading authority. His advice in any technical matter was never sought in vain, more especially because his wide knowledge as a practical farmer made it certain that his recommendations would achieve a nice balance between scientific theory and its application to field problems.

Wood was appointed Professor of Agriculture at the Imperial College of Tropical Agriculture in October, 1927 and served in that capacity until 1938. Many of the students who passed through his hands are now serving in key posts throughout the Colonial Empire, and the standard of their work is a testimony to his quality as Professor of Agriculture. These students recognise their indebtedness to his teaching, and the number of

them that have kept in touch with him in personal correspondence is further acknowledgment of his sterling quality as a man quite apart from his worth as a tutor.

To many of Professor Wood's former colleagues who are still on the academic staff of the College his sudden death has come as a real shock. By correspondence and personal contacts when on leave, most of them have kept in touch with him over the intervening seven years since his retirement. His interest in the progress of the College as an academic institution has never flagged over the whole of that period, and his more personal interest in the welfare of his former colleagues has made them proud to be numbered among his friends. They all valued him as a friend and colleague when he was in residence at the College, but few if any of them realised his true worth in either of these capacities until his retirement from active service. His life and work in Trinidad covered so many different facets that he virtually became an integral feature of College life and from that angle his place has never been filled. "There are men who flee to their hobbies from their work; there are men who shape their work into their hobbies". Professor Wood undoubtedly belonged to this latter class which has achieved so much for British tradition and for the good name of the Colonial Empire.

During the war, Professor Wood took an important and active share in the work of the Home Guard in his part of Suffolk. He lived to see the successful conclusion of the war and to hear the declaration of peace in our time once again. It is the regret of all his friends that he will not be with them in the coming years to enjoy the fruits of victory. His work will survive him and his memory will not fade as long as there remains any of his old associates and friends to whom it will endure as a source of inspiration and encouragement to maintain the high standard of life and duty which he set them.

OBITUARY

MR. DE LISLE H. A. CORBIN

The unexpected death of Mr. Corbin, Manager of the College Hostel, announced in our last issue, came as a very great shock to his colleagues on the staff of the College, as well as to students in residence, College servants and his many friends in St. Augustine. The news will be sadly deplored as it spreads among his wide circle of acquaintances throughout Trinidad and the British West Indies, and indeed in all parts of the Empire wherever past College students are working.

De Lisle Hurley Alleyne Corbin was born in Barbados on 22nd May, 1891, and was educated at the Combermere School in Bridgetown. He joined the clerical staff of the Imperial Department of Agriculture, forerunner of the College, in 1910 and served successively under Sir Daniel Morris and Sir Francis Watts, Commissioners of the Department. In September, 1922, when the Imperial Department moved its headquarters to Trinidad and became merged with the West Indian Agricultural College, Mr. Corbin was first assigned to the administrative section. Later, he was appointed Accountant of the College, which post he held until 1928. In the meantime, after the College had acquired Imperial status in 1924, Mr. Corbin was made Manager of Milner House, first opened as a hostel for students in July, 1927. He served in this capacity until the time of his death, so that he has been actively associated with the College in Trinidad and with its predecessor institute in Barbados for 35 years.

Mr. Corbin gave devoted and loyal service to the College in the difficult and exacting post of Hostel Manager. He was genuinely interested in the welfare and activities of young men at the College and his well known hospitality at home endeared him to every class of student. His advice and assistance in personal matters were constantly solicited and never sought in vain, particularly by West Indian students. His naturally kindly attitude and his obvious sincerity and forthright manner earned him the respect and affection of the staff, all of whom feel they have lost a real friend.

It is in connection with cricket that Mr. Corbin will best be remembered among his out-of-door interests. In his youthful days in Barbados, Mr. Corbin was an enthusiastic playing-member of the Pickwick Club where his deadly bowling was a valuable asset to his side. In Trinidad, he represented the College for several seasons as a regular member of the eleven, though his longest association with College cricket was in the capacity of umpire. His umpiring a match usually assured a keen contest, for his knowledge of the finer points of the game was unrivalled and his decisions were rarely questioned. In the realm of higher cricket, the visit of any first-class team to Trinidad would unfailingly attract him to the Port-of-Spain Oval; his absence from the members' stand will be keenly felt in future years, for his was the devotion to cricket that one associates only with the "old brigade" at Lords.

In his work at the College and in his social activities at home, Mr. Corbin was ably supported by his wife. Their many contributions to the amenities and entertainments within the College precincts and St. Augustine generally will always be remembered by their numerous friends. Besides his wife, Mr. Corbin has also left to mourn his death, a son who is a magistrate of Trinidad, and a daughter who is married to a former sugar technology student at the College, at present residing in British Guiana. To them our sincere sympathy is offered in their bereavement over their loss.

(IV) NEW HEBRIDES

BY

C. Y. SHEPHARD
(*Carnegie Professor of Economics, Imperial College of Tropical Agriculture*)

Geography.—The islands of the New Hebrides form an incomplete double chain stretching in the form of a Y in a north-north-west direction for about 550 miles, lying between 12 and 20 degrees south latitude and 165 and 170 degrees east longitude. Espiritu Santo, the largest of the islands, is 76 miles long and 45 miles wide, with an area of approximately 1,500 square miles, being a little smaller than the island of Trinidad. Malekula, the next largest in size, is 46 miles long and 23 miles across. Santo and Malekula are mountainous, rugged, heavily forested and well watered. Parts of Santo rise to over 6,000 feet. Other large islands are Efate, Ambrym, Erromanga, Epi, Aoba, Pentecost and Maeovo; and Gaua and Vanua Lava of the Banks Group. There are about 60 additional small islands. The total area of the group is 5,700 square miles.

There are three active volcanoes in the Group situated on the island of Tanna, Ambrym and Lopevi, respectively. Ambrym volcano periodically erupts with great severity.

The Group possesses four good harbours, Vila and Havannah Harbours on Efate, and Ports Sandwich and Stanley on Malekula. There are, in addition, several good sheltered anchorages. The Headquarters of the Administration are situated at Vila, which is also the commercial centre of the Group. Most of the large islands possess rivers which are navigable to boats and small motor craft for several miles.

Climate.—The climate is hot, humid and enervating. There are two ill-defined seasons: the hot and wet season extending from November to April, and the relatively dry and cool season from May to October. The annual rainfall ranges from about 50 inches in the extreme south to over 200 inches in the extreme north.

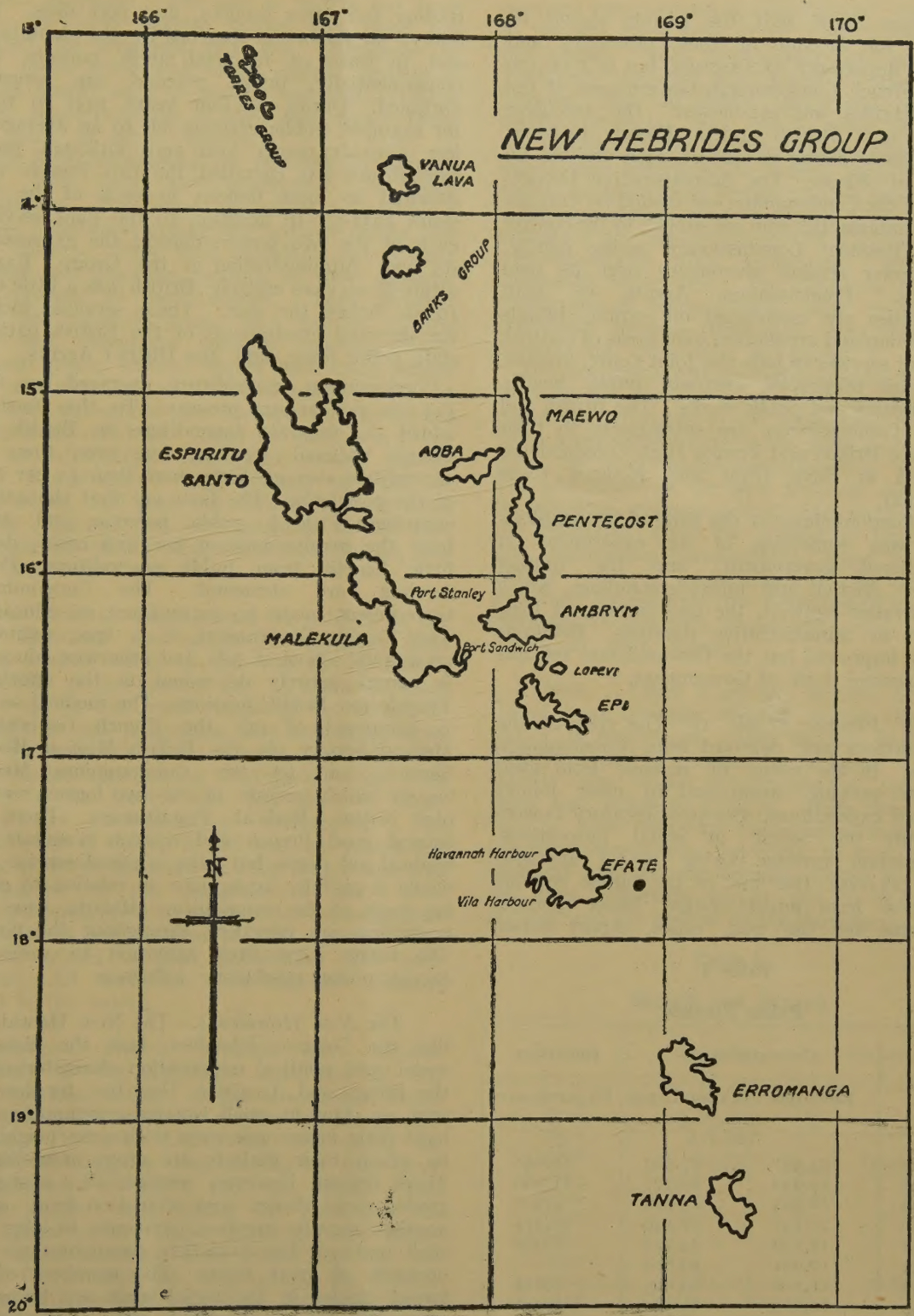
Population.—The Group is very sparsely populated, the total population being estimated at about 43,000, but the primitive state of the interior of several of the islands has precluded the taking of a reliable census. Malekula is credited with the largest population, about 7,000 natives, while Santo, Pentecost, Tanna and Aoba each contains about 5,000 to 6,000. The non-native population is a little over 3,000 of whom 2,000 are Tonkinese. The European population numbered about 900 pre-war of whom about 700 were French, and 200 British, nationals.

History.—The New Hebrides were discovered in 1606 by Pedro de Quiros, a Portuguese navigator in the service of the King of Spain, who named the island where he first landed, "Tierra Austrialia del Espiritu Santo" in the mistaken belief that he had found the long-sought Southern Continent. Little more was heard of the Group until 1768 when the French navigator, Bougainville, sailed between the islands now known as Santo and Malekula, and thereby disproved de Quiros's claim. It remained for the great navigator Captain Cook to discover and chart the greater part of the Group in 1774, and to give the Group its present name.

The New Hebrides remained virtually a "no man's land" until late in the 19th century, the principal European visitors being whalers, sandalwood gatherers and recruiting agents. Thousands of natives were carried off to the plantations in Queensland and elsewhere. Missionaries had made their appearance in the Group during the 1830's, and, although their early efforts were interrupted by a series of murders, they gradually exerted increasing influence on the native population.

Government.—British and French planters and traders drifted into the Group during the latter half of the 19th century, and both Great Britain and France were petitioned to annex the Group, but neither was willing to do so, and in 1878 the islands were declared neutral by these two Powers. One of the most serious of native outbreaks occurred in 1886 and necessitated a French demonstration of force from New Caledonia. This event led, in 1887, to an Anglo-French convention, by which each nation agreed not to exercise a separate control over the Group, and a mixed commission of naval officers was established for the surveillance of the islands. The commission consisted of the respective Captains and two officers from each of the two warships which then paid periodic visits to the Group and was charged with the protection of the lives and property of French and British subjects. The number of settlers steadily increased, and, as the machinery of Government still remained unsatisfactory for dealing with disputes between British and French landowners, and between the settlers and the natives, the settlers established an Arbitration Court of their own. The Joint Naval Commission, however, pronounced its veto, and the Court was dissolved. The Group had become of sufficient importance by 1902 as to warrant the appointment of French and British Resident Commissioners. A later Anglo-French agreement of 1904 provided for jurisdiction over the natives and for the appointment of a commission to settle disputes between French and British subjects. The natives displayed much unrest, and in 1905 a joint punitive expedition was considered necessary.

The Condominium.—In the meantime, strong feeling was aroused in Australia owing to the disabilities suffered by the British settlers,


NEW HEBRIDES GROUP
166°
167°
168°
169°
170°
13°
14°
15°
16°
17°
18°
19°
20°
TORRES GROUP
VANUA LAVA
BANKS GROUP
ESPIRITU SANTO
AOBA
MAEWO
PENTECOST
Port Stanley
AMBRYM
MALEKULA
Port Sandwich
LOPEVI
EPI
Havannah Harbour
EFATE
Vila Harbour
N
ERROMANGA
TANNA

Australians urged that the islands should be annexed on account of their proximity and strategic importance to Australia, but in 1906 the British-French Condominium Government of the New Hebrides was established. The executive consists of a British and a French Resident Commissioner acting in concert, each assisted by a staff of officers. The Administrative Departments of the Condominium are staffed by Officers of both nationalities who are subject to the control of the Resident Commissioners acting jointly. Each power retains sovereignty over its own nationals. Condominium Agents of both nationalities are established on various islands of the Group and are allotted joint areas of control. The joint services include the Joint Court, finance, posts and telegraphs, customs, public health, lands registry and public works. The British and French Commissioners are subordinate to their respective British and French High Commissioner stationed at Suva (Fiji) and Noumea (New Caledonia).

The Condominium, at the time of its establishment, was something of an experiment in international government, and the mutual suspicion, friction and misunderstandings, which had prevailed between the two nations, at first, resulted in administrative paralysis. Relations steadily improved but the Condominium remains a cumbersome form of Government.

Public Finance (*Table* 1).—The cost of the joint services are defrayed from Condominium revenue. In the event of revenue from local taxation proving insufficient to meet jointly approved expenditure, the two Signatory Powers contribute the deficit in equal proportions. Condominium revenue during 1935-9 averaged about £25,000. The bulk of the public revenue is derived from import duties. Minor sources of income are the post office, export duties, trading and other licences, and port dues. The bulk of the imports is absorbed by the plantations, and, in times of financial stress, imports, and consequentially, public revenue, are severely curtailed. During the four years 1931 to 1934, for example, public revenue fell to an average of less than £11,000 a year and, although public expenditure was curtailed, the two Powers were required to meet deficits in each of the five years 1931-5. In addition to the joint services, each of the two powers defrays the expenses of its own Administration in the Group. Expenditure in services entirely British was a little over £9,000 before the war. These services include the personal emoluments of the British national staff, police force, and the District Agents.

Table 1

Public Finance

Year	Condominium		British*
	Revenue £	Expenditure £	Expenditure £
1927	24,497	17,907	16,048
1928	27,932	28,777	11,966
1929	28,624	25,892	9,506
1930	20,152	28,140	10,314
1931	11,132	24,429	8,968
1932	10,021	19,802	—
1933	11,126	19,019	8,851
1934	10,719	23,362	9,346
1935	23,008	26,102	8,900
1936	22,220	21,866	9,600
1937	27,729	21,980	9,496
1938	27,614	23,917	9,187
1939	25,660	23,367	—

* The French Government maintained similar national expense services.

Condominium expenditure averaged less than £24,000 per annum pre-war. To this must be added the separate expenditure on British and French national services, but even then the expenditure averages little more than £1 per head of the population. The facts are that the natives contribute little to public revenue; and, apart from the maintenance of law and order, derive little benefit from public expenditure. Public services are elemental. The Condominium Government incurs no expenditure on education. The French Government, it is true, maintains an infants' school at Aila, but otherwise education is almost entirely dependent on the efforts of French and British missions. The medical service is composed of (*a*) the French Government Medical Service (*b*) the British Mission Medical Service, and (*c*) the Condominium Medical Service which consists of the two former services plus Native Medical Practitioners. There are several good French and mission hospitals and medical aid posts, but the medical service as a whole is pitifully inadequate in relation to pressing needs of the community. Malaria, yaws and hookworm are prevalent throughout the Group. The native pays little attention to sanitation except under missionary influence.

The New Hebrideans.—The New Hebrideans, like the Solomon Islanders, lack the elaborate social and political organisation characteristic of the Fijians and Tongans. They live, for the most part, as clans in small isolated communities and have little intercourse even with near neighbours to whom their dialects are often unintelligible. There remain, however, vestiges of a system of graded social classes and promotion from one to another usually involves payments in pigs and shell money. The initiation ceremonies are the occasion of great feasts. The members of the lowest grades in the social scale are known in pidgin English as "rubbish men". Clothing is scanty and most frequently consists of a bark-cloth girdle and a loin cloth for a man and a fringed skirt for a woman. The piercing and distention of the ear lobes is common. The distended lobes furnish a convenient means of carrying pipe, pouch and matches. The wall of the nose is generally pierced to receive a short

wooden ornament. The hair is frizzed out in a mop and large wooden combs and twigs are inserted for ornament and use. Necklaces of shell, teeth, string and watch chains; armlets of plaited straw, shell or beads; ear-rings of large safety pins; pendants of shell and boar's tusks are worn in great variety.

The New Hebrideans are ferocious in appearance and have the reputation of being treacherous; Europeans undoubtedly deserved a similar reputation among the natives during the 19th century. They have abundantl and at their disposal and generally produce all they consume and consume all they produce. Their principal crops are coconuts, yams, taro, manioc, breadfruit and pineapples. Oranges, lemons, limes, avocado pears, custard apples and many edible nuts and roots are to be found scattered in fair quantity throughout the Group, but they are not specially cared for. Pigs and poultry are kept and not infrequently share their owners' habitations. Cannibalism was formerly general on every island, and persisted until recently in some islands. Human flesh was required in the performance of certain ceremonies but the pig has now been substituted.

Land Tenure.—Land owned by settlers in the New Hebrides was acquired originally from native owners, either by purchase or by barter. Ownership at the present day is based on these native deeds, but such deeds do not constitute a valid title until judgments have been pronounced upon them by the Joint Court. Approximately 1,000 claims representing 2,125,000 acres were lodged in the Joint Court, but many of these claims are conflicting or overlapping. The adjudication of claims in the southern islands has been completed, but work on other islands was still in progress at the outbreak of war. Due consideration is given to the needs of the indigenous population in adjudication of land claims. The Torrens system of land registration has been adopted. All land not thus acquired remains vested in the native.

Plantations.—French interests have become dominant in the plantation industries of the New Hebrides because of the advantages which French subjects enjoy in respect of labour and markets. The New Hebrideans are under no necessity to engage in wage-earning for they have abundant land on which they can subsist. The French planters rely mainly on Tonkinese for their labour force. These labourers were introduced under contract from Indo-China by the French Government for employment by French settlers. The term of contract is five years, with the option of re-engagement for further terms of one or two years, or repatriation at the end of the term. Wages, pre-war, were 80 francs (then about 13/- per month, but subsequently less owing to the depreciation of the French franc), plus food, clothing and lodging. The Tonkinese numbered over 5,000 in 1929, but, when the prices of copra and cacao fell during the early 1930's, their numbers were reduced to about 1,000. Just prior to the war there were about 2,000 Tonkinese in the Group. The employment of indentured Tonkinese labourers was denied to the British planters, and, as native labour was short in supply, irregular and much more expensive, the majority of the British planters either abandoned their enterprises or sought French nationality. In 1940 those British planters who secured a recommendation from the British Resident were permitted to employ indentured Tonkinese, but communications with Indo-China were soon afterwards interrupted. The Tonkinese have the reputation of being harder, more regular and intelligent workers than the New Hebrideans though not physically so strong.

The area cultivated on European-owned plantations is not known accurately but it is estimated that there are 33,000 acres under coconuts, 9,000 acres under cacao, 7,000 acres under coffee and 125 acres under miscellaneous products. The plantations in the New Hebrides are owned by individual planters and are not, as they are in the Solomons, under the control of large overseas Companies. Consequently, there is much greater variety in plantation methods. In some instances, for example, the fields consist of mixed plantings of coconuts, cacao and coffee, and in others of pure stands.

Exports. (*Tables* 2 and 3).—Exports from the Group were seriously affected during the early 1930's in respect of value by the world-wide depression, and in quantity by cyclones. In 1926 exports were valued at £374,229; in 1934 their value had fallen to £49,933. There was subsequently some recovery and exports during the five years immediately preceding the war (1935-9) averaged £130,000 per annum. Copra is by far the most important export and it is on this product that the welfare of the European planters,

Table 2

Imports and Exports

Year	Imports £	Exports £
1924	92,201	
1925	217,863	
1926	197,840	374,229
1927		
1928		
1929		
1930		
1931		
1932	81,587	78,601
1933		
1934	75,993	49,933
1935	115,492	130,937
1936	123,800	122,068
1937	152,722	149,247
1938	111,867	120,211
1939		123,921
1940		
1941	88,800	107,688

Table 3

EXPORTS

Comparative Table of Quantities and Values of Exports

	1934*		1935		1936*		1937		1938	
	Tons	Value (a) £	Tons	Value (b) £	Tons	Value (b) £	Tons	Value (b) £	Tons	Value (b) £
Copra and Coconuts ..	7,033	15,019	9,899	61,874	10,467	90,291	11,839	101,760	11,509	75,130
Cocoa ..	1,728	19,512	2,672	42,047	891	12,026	1,448	30,167	1,893	28,332
Coffee ..	318	9,624	366	19,367	307	13,404	437	13,745	621	12,876
Cotton ..	19	307	33	966	25	713	6	151	28	497
Trochus and Burghaus shell	130	2,970	98	3,594	106	3,381	58	1,752	77	1,350
Maize ..	43	209	106	283	1	1	3	3	43	26
Sandalwood ..	100	1,446	66	1,704	81	1,656	63	902	79	1,215
Wool ..	9	441	6	515	4	232	5	280	5	331
Hides ..	28	273	23	287	32	302	41	376	43	357
Miscellaneous	229	93	153	257	64	38	134	97	55	97
	9,587	49,933	13,423	130,937	11,979	122,068	14,034	149,247	14,353	120,211

(a) Converted at the fixed rate of 124 francs=£1.

(b) Converted at the rate of exchange of the day.

* In these years exports were unfavourably affected by cyclones.

and the magnitude of the public revenue, primarily depends. Copra is also the principal source of cash income for the natives, and, although their money requirements are modest, the reduced value of copra during the early 1930's induced them to work in unusually large numbers on the plantations.

Cacao ranks second among exports. The bulk of the world's cacao is produced by peasants, but cacao in the New Hebrides is entirely a plantation crop. Soil and climate are favourable to this crop, and yields appear to be heavy. Improvement in yield and quality could be effected readily by the use of cuttings from Imperial College clones, and there is scope for planting both by Europeans and natives. Coffee and cotton are subsidiary exports produced exclusively on European plantations. The livestock industry is not important, but cattle are raised on coconut plantations for the primary purpose of controlling weed growth and the subsidiary purposes of supplying fresh meat and milk. One interesting enterprise is a sheep station, running about 3,000 head, in the island of Erromanga. Shell, bêche-de-mer and sandalwood are bought from individual natives and Asiatics and are exported in small quantities.

French colonial products enjoy highly preferential treatment in France, and practically all the exports go to France. The value of produce exported as British by British firms and planters represented only 2 per cent. of the total. The New Hebrides are little more than 1,000 miles from Australia, but the Dominion buys little produce from the Condominium, and is interested in the Group mainly because of its strategic position and as a market for Australian products.

Table 4

Exports

Countries of Destination

	1935 per cent. by Value	1936 per cent. by Value	1937 per cent. by Value	1938 per cent. by Value
France ..	92	91	95	98
Australia ..	5	7	3	1
New Caledonia	2	1	2	0
China ..	1	1	0	1

Imports.—The natives are almost wholly self supporting in respect of foodstuffs. The principal imports of food are rice, flour, sugar, tinned fish and meats, the bulk of which is purchased as a convenient means of feeding Asiatic and native labour on the plantations and elsewhere. Most of the other foodstuffs are imported for consumption by Europeans. Other imports are primarily for the use of planters and Government and consist largely of building materials, agricultural machinery, boats and motor cars, petrol, kerosene, lubricating and fuel oils, and gunny bags. Australia supplies the bulk (50 per cent. to 70 per cent.) of the imports, with France and her colonies next in importance.

Table 5

Chief Imports

	1934 (a) £	1935 (b) £	1936 (b) £	1937 (b) £	1938 (b) £
Rice ..	3,335	6,737	9,450	11,834	8,470
Flour ..	2,040	3,472	3,317	4,773	3,057
Biscuits ..	568	953	728	1,512	852
Tinned fish ..	590	1,212	1,766	3,325	1,558
Tinned milk ..	759	1,208	908	951	952
Other Tinned goods and groceries ..	1,164	1,766	3,153	4,422	2,927
Sugar ..	1,316	2,111	2,000	2,213	2,507
Wines ..	2,420	3,729	2,841	4,296	3,771
Spirits ..	1,845	3,369	1,779	2,043	1,969
Beer ..	1,277	1,638	1,060	1,394	1,013
Tea ..	800	1,089	1,030	1,270	1,020
Tobacco ..	3,819	5,126	4,997	5,502	4,307
Soap ..	416	517	775	1,102	563
Building Materials ..	3,023	6,774	4,512	10,885	9,646
Agricultural machinery, boats and motor cars ..	3,796	8,445	5,869	9,742	6,998
Cement ..	1,018	1,311	700	985	1,017
Petrol ..	2,024	2,148	2,639	5,674	7,257
Lubricating oils ..	1,570	3,230	959	846	1,794
Kerosene ..	1,323	1,814	1,712	4,706	1,672
Sacks ..	2,084	3,175	4,150	4,626	5,327
Miscellaneous	40,806	55,668	69,455	69,561	43,766

(*a*) Converted at the fixed rate of 124 francs=£1.

(*b*) Converted at the current rate of exchange. Share of imports of British and French importers respectively 33 per cent. and 67 per cent. by value.

Table 6

Source of Imports (by Value)

	1935 %	1936 %	1937 %	1938 %
Australia	48	70	68	49
*France and her Colonies	21	16	18	26
U.S.A.	12	2	2	7
Japan	7	5	4	7
United Kingdom ..	3	2	2	3
Hong Kong	1	1	2	3
Dutch Indies ..	2	2	1	2
Miscellaneous ..	6	2	3	3

* Increase due chiefly to imports of foreign fuel oils from depot in New Caledonia and rice from Indo China.

Effect of the war.—The Japanese military forces did not penetrate so far as the New Hebrides, and certain islands became supply bases for the Allies counter-attack. A few of the plantations have been converted to military use, either as aerodromes, military camps or supply dumps, but the others have been kept in fair condition with the aid of Tonkinese labourers, and the problem of rehabilitation presents less difficulties than in the Solomons. Good military roads have been constructed in certain islands, but it is doubtful whether the Condominium revenue will be capable of standing the strain of their maintenance in post-war years. Pre-war, the road system was only rudimentary except in the neighbourhood of the capital, Vila, and in the island of Tanna.

The New Hebrides appear to the visitor as an economic and cultural back water. Small areas have been carved out for European exploitation with the aid of imported labour, and, apart from missionary influence, the natives remain almost untouched by European civilisation. The New Hebrideans are among the most backward and primitive peoples of the South Pacific. So long as public revenue depends mainly upon small-scale European enterprises, it will be impossible to provide social services on a scale adequate for the proper development of native welfare.

PO-YOK AND ISANO OILS

Two drying oils which have come to the notice of the paint and varnish industries in recent years are po-yok and isano oils. Po-yok is obtained from a tree which occurs in Liberia, Nigeria, the French Cameroons and Sierra Leone. Not all samples of this oil have been found to be identical as some will gel under heat-treatment as tung oil does, while others fail to polymerize when so treated. The fatty acids of po-yok oil of the gelling variety consist mainly of licanic acid (41 per cent.) and elaeostearic acid (31 per cent.). Dr. Jordan has reported that gelling po-yok oil has valuable varnish and paint-making properties, generally superior to those of linseed oil and of the same type, as, but not the equal of, those of tung oil. This oil in normal times would not be of particular interest to the varnish trade on account of the restricted supplies available. Further, the prospects of increasing supplies by cultivation are not encouraging in view of the slow growth of the trees and their irregular fruiting. Isano oil is obtained from trees occurring widely in the French and Belgian Congos and found also in Nigeria and the Gold Coast. In these two Empire countries, however, these trees are nowhere sufficiently plentiful to afford possibilities of commercial exploitation. Isano oil is considered to be suitable as a substitute for linseed oil in the manufacture of varnishes, although the untreated oil does not dry even after exposure for a long period. The oil requires heat-treatment in contact with hot air to render it capable of drying rapidly.—(*Chemistry and Industry*, No. 37, p. 294, 1945).

PRELIMINARY TESTS WITH DDT AGAINST INSECT PESTS OF FOOD-CROPS IN THE LESSER ANTILLES

BY

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Introduction

At various times during 1944 and the early part of 1945 preliminary tests of the insecticide DDT were conducted in St. Lucia, B.W.I., to determine its efficacy against local insect pests of vegetables and staple food-crops and to gain information regarding its applicability in other directions of interest to the planting community.

As manufactured, DDT is a finely ground powder, but after a short period of storage it acquires an uneven texture due to the aggregation of particles into nodules. The insecticide may be applied as a dust, either pure or diluted with an inert carrier, as an aqueous suspension, as a solution in oil or other solvents, or as an emulsion.

Methods of application

If the material is to be applied as a powder it should be rendered uniform before use by sifting through a cloth. If the area due for treatment is small the powder may be sifted as it is dispersed: the operator merely carries a supply of undiluted DDT in a small bag of coarse cloth and liberates a convenient quantity of dust by tapping its sides with a short stick. When large areas require treatment the sifted powder should be mixed with a suitable diluent such as talc or sulphur and applied by means of a dusting machine. Small areas should be dusted during periods of calm, but when large tracts need to be covered advantage may be taken of moderate uni-directional air movement to achieve wide dispersal.

In preparing an aqueous suspension of DDT the dust should be mixed with a little water and ground to a cream-like consistency before being diluted. If this is not done, nodules and grains of DDT rapidly settle at the bottom of the tank with the result that the amount of insecticide leaving the nozzle while spraying is in progress varies from moment to moment according to the degree of agitation of the reservoir. Such suspensions should be applied only with sprayers from which the nozzle may be detached for cleaning.

DDT is soluble to a greater or lesser extent in a wide range of liquids; the following, taken from among the most common, will dissolve DDT in the proportions given; tetralin, 56 to 60 gm. DDT per 100 ml.; cotton-seed oil, 9 gm. per 100 ml.; crude kerosene, 7 to 8 gm. per 100 ml.; fuel oil, 8 gm. per 100 ml. A solution of DDT in kerosene may be sprayed with good effect on the interior surfaces of buildings and on sacks, stored lumber and similar substrata, but plain oil solutions of DDT should not be applied to animals nor be allowed to remain in contact with the skin of the operator, as a certain amount of DDT may be absorbed into the body; moreover they should not be sprayed on plants, as the risk of foliage being scorched by the oil is considerable.

When small areas require treatment emulsions of DDT have certain advantages over the preceding in that they are less subject to wastage in moving air during application and to erosion subsequently, and may be applied with accuracy to all surfaces including leaves and the hair of animals, and in some cases, due to their physical structure and their accessory constituents, have an immediate knockdown effect on insects. One such emulsion, which has been used throughout the present series of trials is made up in the following proportions: DDT, 40 gm; tetralin, 70 ml.; Triton B-1956, 10 ml.; soap, 1 gm.; water 145 ml. The DDT is dissolved in the tetralin and the spreader is added; the soap is dissolved completely in the water, which is then poured into the foregoing mixture. The quantities shown make 253 ml. of stock emulsion weighing 266 gm., and containing approximately 15 per cent. DDT. This may be diluted with *soft* water as follows to give different concentrations of the insecticide:

One part stock solution by volume diluted with	*Approximate concentration of DDT in spray*
1 part water	7.7 per cent.
2 parts water	5.2 ,,
3 parts water	3.9 ,,
4 parts water	3.1 ,,
6 parts water	2.2 ,,
15 parts water	1.0 ,,

The spray may be applied by means of a hand sprayer of the atomising type or with a knapsack sprayer.

The ideal spray deposit consists of an even coating of minute and almost contiguous specks. This condition is most nearly approached in practice when spraying is stopped just before the sprayed surface becomes completely wet. A plane surface sprayed to this point with the above DDT emulsion will contain, when dry, an amount of DDT which varies with the concentration used, as shown below.

Concentration of DDT in spray	*Milligrams of DDT per square foot*
7.7 per cent.	300
5.2 ,,	203
3.9 ,,	152
3.1 ,,	120
2.2 ,,	86
1.0 ,,	39

Contact effect of DDT emulsion

An emulsion containing 3 per cent. of the insecticide has been used as a contact spray against cockroaches, termites (scouting parties), ants, mosquitoes, sandflies and flies invading buildings, against the aphid *Toxoptera aurantii*

(Boyer) on citrus, and at 5 per cent. concentration against three-quarter to fully-grown larvae of the frangipani hawk moth (*Pseudosphinx tetrio* L.) It was found in all cases that the insects were incapacitated as soon as they became completely wetted. The sandflies and the ants (*Prenolepis longicornis* Latr.) were immediately immobilised and killed; the mosquitoes were killed if thoroughly wetted, but otherwise, after an initial collapse, recovered sufficiently to move their legs but did not regain the power of flight or of co-ordination before death supervened. Flies were knocked down if wetted or were driven to escape from the sprayed zone. Samples of the escaping flies were collected at closed windows and were transferred for observation to humid cages some distance from the sprayed area. A hundred and sixty-six flies were so observed during a period of two months and it was found that in approximately 73 per cent. of cases death occurred after a lapse of between one and six hours. The aphids were killed within a few moments of being wetted by the spray. Individuals which did not receive the maximum dosage ceased to feed and wandered about the drier portions of the twig until they fell. The fallen insects were collected and kept under observation in a moist cage; all were dead within nine hours while an unsprayed colony of about the same age, taken from a neighbouring twig and placed in a second cage, showed less than one per cent. mortality in the same period. A spray of 5 per cent. DDT emulsion when directed on to larvae of *Pseudosphinx* caused immediate cessation of feeding and induced the quasi-defensive upreared attitude. This attitude was maintained by one large specimen for several hours. All, sooner or later, began to wander over the host plant and in due course fell to the ground. Recovery of muscular activity followed drying of the spray on the derm of the insects, but feeding was not resumed: it was found that a second complete wetting following within two hours of the first resulted in immobilisation and death without any intervening period of renewed activity.

Residual effect of DDT emulsion

In cage tests of the residual effect of DDT emulsion populations of field-caught pests were each divided into two groups which were caged separately. The cages were maintained at room temperature (72° to 83°F.) and a high humidity (R.H. 85 to 98 per cent.), and leaves of a normal host plant were laid to form a complete cover over the floor of each. The leaves supplied to one cage were collected from plants which had been sprayed to the point of wetting some hours prior to use, so that the spray deposit was dry when the insects were introduced; those supplied to the other were taken from unsprayed plants of the same species. The results of these tests are summarised in Table I.

It is evident that the residual effect of 1 mg. DDT per square inch on the surface of the leaves used is sufficient under ideal conditions to cause death of a wide range of insect pests traversing them within at least 48 hours of spraying. In the field, however, the distribution of a lethal dosage of DDT over the plant may not be even, either through initial failure to secure uniformity of application, or as a result of subsequent erosion of the deposit by rain. Uniform spraying of plants is difficult where the crop is of a low bushy habit, as the outer leaves mask those inside, and in such cases care should be taken to supplement the external spraying with a brief application to the lower leaf-surfaces from points within the canopy. It is necessary to train and supervise carefully labourers delegated to this work, as all too frequently much spray is wasted through the nozzle being held near to some obstruction (such as a leaf or stem) down which the liquid courses freely to the soil. Field trials have been initiated to test on a larger scale the effect of DDT on pests of food-crops, and these are still in progress. It is not proposed here to present details of what has been established, but it may be recorded that in tests against the green stink-bug (*Nezara viridula* (L.)), the cabbage butterfly (*Ascia monuste* (L.)), the diamond-backed moth (*Plutella maculipennis* Curt.) and *Thermesia gemmatalis* Hubn., a common pest of cow-peas, the results of spraying with DDT emulsion at about 1 mg. DDT per sq. in. are well in accordance with those obtained in the cage tests.

Durability of residue in field

The effect of rainfall on the spray deposit on a plane surface both before and after it has dried was investigated by spraying a series of microscope slides and exposing them for varying periods to steady rain. The initial deposit, applied by a hand atomising sprayer from a distance of four feet was very uniform and consisted of crystalline aggregates, ranging between 27μ and 84μ in diameter, of a frequency of 38 per sq. mm. It was found that samples taken at intervals of 15 minutes, 30 minutes, one hour and two days (the last representing 1 inch and 60 parts of intermittent rain) revealed a progressive erosion of crystal aggregates. In a deposit eroded soon after application it was found that the crystals, though recognisable, were small and acicular, indicating that a portion of the DDT content of the spray had been washed away before it had crystallised out of solution. The removal of dry deposits of crystals appeared to be due to the mechanical action of rain-drops as they impinged on the slides: the careful addition of a drop of rain-water to the sprayed surface of a slide failed to result in any loosening or removal of DDT crystals detectable by normal microscopic observation. The degree of erosion of DDT from the exceptionally smooth surface used in the observations was probably maximal but would seem to justify the conclusion that moderately heavy showers are likely to reduce seriously the residue of DDT deposited from emulsions of the type tested where such residue occurs on the upper side of the leaves. The largest crystal aggregates were found to be relatively durable and it is

DDT and Mammals.—The DDT emulsion described above has been sprayed at 2 per cent. strength on dogs and livestock without producing any ill effects on the animals, while pure sifted DDT dust has been applied to dogs at the rate of one gram per square foot without causing any ill effects after 15 monthly applications and without provoking any avoiding reaction on the part of the animal. The latter effect stands in marked contrast to that of powders containing pyrethrum.

An interesting phenomenon observed while a public market in Antigua was being sprayed with 3 per cent. DDT emulsion at dusk was the sudden incapacitation of several bats hunting through the spray-saturated atmosphere. The animals were forced to land on the floor where they remained for about 15 or 20 minutes before taking to flight again in an apparently uninjured condition. It was presumed that the disorganising effect was due to wetting and irritating properties of the emulsion, and had no connection with the DDT content. This view subsequently received some corroboration when an emulsion of approximately the same composition as the former, but without the DDT, was sprayed at the same dilution on the same genus of bats (*Molossus*) spp.) stirred into activity at dusk in a disused storehouse: the bats were equally promptly brought down, collected, and kept under observation. They were completely wet but not physically enfeebled, to judge by their normally co-ordinated and vigorous actions when on the ground. When they had dried to some extent they were given their liberty, and they flew off immediately.

To determine what consequences would result to occupiers from frequent and indiscriminate use of DDT in the house the writer, during a 13-month period interrupted for a fortnight and a month respectively, inhaled 100 mg. of sifted pure DDT and drank water dusted with pure DDT at more than 300 mg./sq. ft. daily; at a later date for a period of a month all food taken was sprayed, when prepared and exposed in dishes, with DDT emulsion at 3 per cent. strength until a plane surface exposed at the same time had received 100 mg. per sq ft.; finally, at irregular intervals of about 15 days, the skin of the arms and hands was swabbed with 5 per cent. DDT emulsion and this was allowed to dry, giving a dosage of over 200 mg. per sq. ft. No ill effects of any kind and no symptoms generally associated with DDT poisoning in laboratory tests have been noted, and it is considered that notwithstanding the uncertainty regarding the actual amount of DDT assimilated, the degree of exposure to its influence experienced by the writer to date considerably exceeds that likely to obtain in the course of its normal use about the home.

SOYA BEANS IN NIGERIA

BY

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Introductory

The first recorded trial of soya beans was made in 1910 at Ibadan. The crop was a failure.

In 1928, in response to requests to the United States and Southern Rhodesia for fodder legumes likely to succeed in Nigeria, the Department of Agriculture received several varieties of soya beans. These were grown for some years at Kano, Zaria, Yandev and Ibadan. Yields up to 500 lb. per acre were recorded at Zaria in small scale trials and nodules developed without inoculation. As a fodder plant it was found inferior to other plants, as an export crop it had no prospect at that time in competition with Manchuria, and as a food for human beings it was not seriously considered. Trials were discontinued in 1933. The best of these varieties seemed to be Otootan (black seed) which gave 500 lb. per acre at Zaria and 430 lb. at Yandev in 1930 and 1932. Five varieties from Russia were discarded after two years' trial.

The various Missions, especially the Church of the Brethren Mission at Garkidda on the plateau and the Leper Settlement in Itu in the Eastern Provinces have, from time to time, introduced and tried a number of varieties. They grow the crop solely as a food for human beings.

Variety trials in Nigeria and the Cameroons

In 1937, tropical varieties were introduced and tried by the Botanist at Ibadan and Zaria. These varieties came from Trinidad, British Guiana, Malaya, India, the Philippines, Ceylon, the Dutch East Indies, the United States and South Africa. By this time (1937) Manchuria had been occupied by the Japanese and the United Kingdom had introduced Imperial preference, both factors favouring export from the colonies. Moreover McCulloch had found protein and other deficiencies in African diets at Katsina, and Hartley and Ross drew attention to the difficulty of providing enough concentrate for the high yielding cows being bred at Shika Stock Farm. Later Drs. Johnson and Turner* noted that where institutional diets had been supplemented with protein results had been good.

From 1940 onward the more promising varieties were grown at most of our farms with very variable success. Throughout the Northern sandy belt represented by Sokoto, Daura, Kano, the few varieties tried (including Trinidad) have definitely been a failure. In the Zaria belt

* First Report of Committee on Nutrition in the Colonial Empire, Part II, p. 40.

(Daura, Zaria, Bauchi, Riyom, Zonkwa-Kontagora) variable yields were recorded sometimes as high as 800-1,200 lb. seed per acre, the best yielders being Malaya and Benares which must be planted at the same time as groundnuts (early June) to ripen in October. Losses from splitting in the field have been overcome by adopting Nash's method of cutting and stacking the plants on a threshing flour just as the first pods threaten to split. This method when tried at Yandev and Ilorin caused many seeds to become discoloured or mouldy. Handpicking in the field is essential for good quality there.

Yandev and Ilorin experimental farms represent the 'Middle Belt' with a more variable distribution of rainfall and slightly greater quantity and duration than in the Zaria belt. Yields of soya beans vary between 100-1,100 at Yandev but are mostly 300 to 600 lb. per acre at Ilorin. It seems that the erratic distribution of rainfall at Yandev, especially the uncertain "short dry" and uncertain onset of the main dry season make soya beans more of a gamble there than in the Zaria belt which also has the advantage of negligible loss of viability in the seed stored during the severe dry season November to April.

At Ibadan the Botanist has tried most of the varieties in Nigeria and the best seem to be Misc. 28 and Trinidad. Here soya beans are grown only as a late crop because vermin are too destructive to early sowings. Sown in August and harvested in December on reasonably good land 500-700 lb. seed per acre have been obtained. Unfortunately in the long period between harvesting and sowing there is a serious loss of viability especially in May and June, but Malaya, Misc. 28 and Misc. 33 are better than other varieties in this respect.

In the Cameroons soya beans have been tried at Bamenda (4,500 ft.) and Esosong (3,300 ft.) which lies on a slope of Mt. Kupe. Excellent vegetative growth is made at both places but yields of seed have been erratic at Bamenda where Trinidad, Benares and Malaya were tried: late sowings of Trinidad were best. At Esosong most of the varieties tried at Zaria were grown, Benares and Malaya being among the best, giving yields up to 900 lb. per acre.

At Itu Leper Settlement one variety is successful which will not flourish elsewhere.

Peasant Cultivation of Crop

The peasants have not begun to grow soya beans in Nigeria, except here and there under the direct encouragement and example of Europeans, *e.g.* at Yandev and Ilorin, in the Anchau "corridor" in Zaria Province, and near Bamenda. No information is available from Garkidda and Itu as to how far the people are using the beans as part of their diet except in so far as they receive S-B milk, etc. in Mission hospitals. There is no record from any part of the country of serious loss of crop due to plant diseases.

Food Values

Much has been written in enthusiastic vein of the food-value and palatability of the soya bean but there seems to be some disagreement on this subject *. Tests were carried out at the Nutrition Research Laboratories at Coonoor in India on animals and school children from which it was concluded that soya beans "do not appear to have any advantage over the various common pulses which have long formed part of the diet of the Indian people". Dr. Burns adds "In those eastern countries where soya beans is an important food soya bean products are often prepared for consumption by fermentation which changes the taste and probably improves digestibility"... "In India suitable domestic methods of preparation conforming to the natural taste would have to be evolved and popularised and the process might be a lengthy and difficult one". Dr. Ogle carried out a controlled experiment on school children in Lagos in 1942 using soya bean milk and flour. She concluded that "it is dangerous as well as difficult to interfere with native diets" and recommended that further tests with steamed flour and soya bean milk be carried out and beans distributed to teachers and health workers for trial in their homes. For example, an African assistant has described successful methods of cooking soya beans mixed with cowpeas, which description has been published by the Public Relations Officer, Lagos. The army tried soya beans as part of the rations of West African troops in 1944, but further trials by the Medical Department are needed.

The soya bean is sometimes described as an "oil-seed" and judged as such. Shipments from Manchuria averaged 18 per cent. of oil and recent analyses of soya beans from Northern Nigeria averaged 18.3 per cent.; Nigeria has many "oil-seeds" of higher percentage and higher yield of oil per acre than this and should regard soya bean only as a possible easier or better source of protein, in some parts of the country, than other pulses or animal products. Thus in the Middle Belt soya beans should be tested in field trials against cowpeas, benniseed, Bambarra groundnuts and groundnuts, in the South-West area (Ibadan) against cowpeas, and at Esosong (in the Cameroons) against cowpeas and groundnuts. In the Zaria belt, Benares and Malayan might be tested in field trials against groundnuts and pigeon peas, and Trinidad against cowpeas. Feeding trials for meat and milk production might follow.

As regards the use of cotton seed it is fairly true to say that under pre-war conditions the farmer in the Zaria cotton belt produced 100 to 200 lb. cotton seed (*i.e.* 150 to 300 lb. seed-cotton) per acre but this seed was consumed as fuel by the ginnery (about 7 per cent.), eaten by the goats of the Kano native spinners, shipped to the United Kingdom by exporting firms, or issued free to planters: the only cattle who got any were those kept on Government farms. The farmer who

* See article by W. Burns, *Indian Farming*, 2, 9, 1941.

produced it got back only enough to plant, and it would perhaps be better for him and his land if his wives were to spin and weave his own cotton, and his stock to eat the surplus seed.

Ross and Hartley's figures for these seeds are suggestive :—

Analysis by Agricultural Chemist, Zaria

	Percentage in Dry Matters of			
	Protein	Fibre	Fat	Carbohydrates
Cowpea grain ..	25.6	2.8	3.1	64.2
Groundnut kernels	27.8	3.4	49.9	16.1
Pigeon pea grain	19.1	8.5	2.0	67.0
Soya bean grain	44.1	4.3	24.9	22.1
Cotton seed	25.4	32.0	10.0	20.7
Analysis by Agricultural Chemist, Ibadan				
Groundnut cake (*ex* Apapa soap works) ..	50.6	4.9	10.0	29.6

From time to time ever since 1912 responsible and well informed people have recommended that only the oil of groundnuts and cotton seed be exported and the valuable mineral elements returned to the soil by feeding the 'cake' to stock. These recommendations were ignored.

World Position of Crop in relation to Nigeria

The Colonial Office has recently sent a circular to Colonial Governments which summarises the world soya bean position. Its application to Nigeria is discussed in the following paragraphs.

"The United States has tested some 10,000 varieties though probably less than 100 are now grown on a farm scale." Some 30 varieties have been tried in Nigeria and it seems unlikely that all the suitable (tropical) varieties were included. Some of the 9,900 varieties discarded in the United States might flourish here. The circular also recommends varieties from Southern Rhodesia. The varieties hitherto obtained from those sub-tropical or temperate countries were mostly early maturing and failed in Nigeria.

Dr. Blackman is quoted :—"Finally the strain of nodule forming bacteria which is essential for the fixation of nitrogen by the soya bean is absent from soils in which soya beans have not been grown before. For successful cultivation it is necessary to inoculate the seed prior to sowing". This is not true for Nigeria and the Cameroons. Wherever we have sown soya beans nodules appear here and there on the roots in the first season and are plentiful in subsequent years. In 1930, a trial was conducted at Zaria, some seed being inoculated with inoculum obtained from the United Kingdom and some seed untreated but all plots developed nodules. Again in 1937, inoculum was obtained from the United States and tried at Ibadan but no improvement over uninoculated seed was observed. Nevertheless Royer says that his inoculated plants have more and larger nodules than others, and quotes experiments in Wisconsin showing that some bacterial strains are more effective than others. Dr. Blackman notes "The preparation of cultures must be made within a relatively short time of sowing since the bacteria only remain active for two months even in cool temperate climates". It is possible that the cultures obtained in 1930 and 1937 were dead and arrangements are being made to get improved cultures by air from the United States and East Africa. Mr. Royer's strain was introduced to the Riyom Experimental Farm in 1941. The circular quotes 35 per cent. protein for soya bean and 23 per cent. protein for groundnuts but does not say if these figures are on a dry matter basis. The Imperial Institute analysed Trinidad and Benares soya beans from Northern Nigeria and found 41 per cent. and 40.8 per cent. respectively (compare these with the Zaria figures). The following vitamin figures are given in the circular :—

	Vitamin B	*Riboflavin*	*Nicotinic Acid*
	mg. in 100gm.	mg. in 100gm.	mg. in 100gm.
Groundnut ...	0.9	0.14	17.4
Soya Bean ...	0.7	0.32	4.0

Recent work in Nigeria indicates that Riboflavin is often deficient in African diets.

The various methods of preparation for food are discussed and the preparation of curd, flour, milk and mash, and sprouts are described in detail. The use of products made from the *curd* is recommended to Colonial Governments. Trials of such products have not been recorded in Nigeria.

"To sum up, the high nutrient value of the soya bean is unquestionable but it is important that Colonial Governments should appreciate the position as between groundnuts and soya beans viz. :—

(1) nutritionally they may be classed together.

(2) soya beans as beans or in processed form may prove difficult to introduce into native diets whilst groundnuts are established favourites".

"As an export crop, future prospects depend largely on developments in the Far East. Unless new uses develop rapidly it appears possible that a world surplus of soya beans may arise. At best the crop must be regarded as a speculative one and it would probably be wiser not to concentrate on it to the exclusion of commodities which offer a more assured market".

Conclusion

It is only on the assumptions that soya beans will equal or surpass other plants in yield of protein per acre and that ways will be found of introducing the beans into the diet of the people and their stock that we would be justified in continuing our present policy of recommending its cultivation as a cash or export crop. These two assumptions

need confirmation by field trials on experimental farms and by dietetic research. The results of the numerous "observation plots" summarised here indicate that soya beans are quite likely to surpass other plants in some districts.

References

Report from Experimental Stations in Nigeria and the Cameroons.
Burns, W.—The soya bean, its politics, performances and possibilities. *Indian Farming*, **2**, 9, 1941.
Nutrition in the Colonial Empire.—First Report, 1939
Hartley and Ross.—Feeding of Nigerian Stock.
Royer, H. A.—Soya beans as food. (Revised edition) 1944.
Colonial Office Circular 19618/45.
McCulloch, W. E.—An enquiry into the dietaries of the Hausas and Town Fulani.—Government Printer, Lagos, 1930.
Ogle, L. J.—Feeding tests on soya beans, 1942.
Piper, C. V. and Morse, W. J.—The Soya bean. McGraw Hill, 1923.

Abstracted from an article by W. A. Blann, *The Sugar Bulletin*, Vol. **2**, p.198, 1945.

REVIEW

The Energetic Efficiency and Growth of Animals

"Bioenergetics and Growth" by Samuel Brody. The Reinhold Publishing Corporation. New York. Published 1945. Pp.1023. Price $8.50.

About thirty years ago the Herman Frasch Foundation sponsored a long term research project at the Missouri Agricultural Experiment Station, the purpose being to study the comparative efficiencies with which the matter and energy of feedingstuffs are transformed to meat, milk, eggs and work. The chairman of the committee directing the research is Dr. Samuel Brody and students of animal husbandry and nutrition are familiar with the various reports published, mainly, in the bulletin series "Growth and Development" of the Missouri Station. The present publication "Bioenergetics and Growth, with Special Reference to the Efficiency Complex in Domestic Animals" is an integration of the work previously published together with a detailed evaluation of the massive literature bearing on the subject.

The field of bioenergetics was opened by Lavoisier in 1777, whose researches provided the basis on which the sciences of chemistry and nutrition developed. The principal workers thereafter were von Liebig, von Voit, Rubner and Kellner in Germany, Lawes and Gilbert in England, and Atwater, Armsby, S. R. Benedict, F. G. Benedict, du Bois, Lusk, Forbes and Brody in the United States. Beginning from the body of knowledge collected mainly during the nineteenth century on energy exchanges in organisms, Brody's school was able to devote most of its attention to studying the efficiency of energy transformations in the organism, that is to determine the ratio of the desired form of energy output (as meat, milk, eggs, wool, work, etc.) to the ingoing energy of the feed. The nature of the problem is best stated in Brody's words:

> "The animal husbandman, by employing special techniques, finds it possible to accelerate the speed of growth, milk production, egg production, and muscular work, of his animals. Whether this increased productivity results in greater *immediate* energetic efficiency, of course, depends on the relative acceleration of the productive processes on the one hand and maintenance cost on the other. But supposing that an increase in immediate energetic efficiency occurs, how will this affect the future health, fertility and longevity (factors in *long-range* efficiency) of the animal? How do successive production increments compare with successive immediate and long-range cost increments? Obviously, the efficiency complex must be viewed from four standpoints: that of the animal and that of the animal husbandman, that of immediate efficiency and that of long-range efficiency."

Brody's exposition begins with the First and Second Laws of Thermodynamics and with definitions of terminology. He proceeds to shew how the fractionation of the gross energy of feedingstuffs into net energy, the energy wastage associated with specific dynamic effect and methane production and the losses of energy in urine and faeces vary with the plane of nutrition. The importance of this aspect of energetic efficiency is obvious in view of the traditional method of treating the productive values of feedingstuffs as constants irrespective of the level of feeding.

The influence of metabolic catalysts (enzymes, hormones, vitamins and minerals) on the efficiency complex is studied in detail. Inadequate supplies of vitamins which are components of enzymes result in the concentration of these enzymes falling below normal. When the concentration of enzymes involved in biological oxidations within tissues is subnormal the liberation of the energy of nutrients is incomplete with the consequent voiding of excessive amounts of unliberated energy by the organism. As a further example, when the organism's phosphorus supplies are inadequate the phosphorylation of carbonyl groups, which is an intermediary step in carbohydrate metabolism, is impaired with a reduction in energy liberation. On the other hand excesses of the toxic element selenium inhibits oxidation by destroying oxidation catalysts.

Perhaps the most interesting section of the text to most readers is that devoted to the treatment of growth rates in animals. Here the problem is examined in terms of Brody's theory of growth. In this the growth of organisms is considered to be divisible into two main phases: a self-accelerating

phase followed by a self-inhibiting phase. For each of these phases Brody has developed a mathematical treatment such that the entire growth period from birth to maturity is defined by two constants.

Particular attention is paid to the energetic efficiency and monetary economy of milk production. Comparisons are made on the basis of "Dairy Merit", that is, the milk energy production in relation to digestible energy consumption. The method of evaluating Dairy Merit is described, the basic data being liveweight, milk production (with butterfat content) and feed consumption. The efficiency of egg production and work, in the case of horses, are also examined.

The text should be of particular value to those concerned with the development of the tropical animal industry. Not only the sections dealing with the treatment of experimental data but also those concerned with the effect of the environment on energy conversions could be of great assistance. Certainly much of what Brody's school has done for temperate zone animals could be repeated for tropical livestock without demanding elaborate equipment.

John Duckworth

SPECIALIZED FIELDS IN SOIL SCIENCE *

Soil science is the scientific study of the nature, distribution, origin, use, conservation, and improvement of soils, and the application of scientific principles to their management for plant production and for other purposes.

Soil scientists may specialize along regional lines as well as by crops or by other fields of specialization. Such regional specialization calls for familiarity with the major crops or soil types of the region.

These major fields merge into one another and into related fields, such as horticulture, botany, chemistry, physics, microbiology, plant ecology, plant physiology, plant pathology, genetics, forestry, geography, engineering, economics (production and farm management), and other branches of agricultural science. Many specialists may be qualified in more than one subdivision.

Functions

A soil scientist may specialize in one or more of the following functions:

Research through scientific experiments and field surveys into the nature, origin, management, distribution, use, conservation, and improvement of soils; and into crop production, improvement, and utilization. Other studies include flood control and construction as these relate to soils.

Consulting work regarding soil characteristics in relation to its uses in construction and in planning foundations and subgrades, and for commercial agricultural companies.

Extension of principles of crop and soil science through demonstration and education, including the planning of demonstration farms and direct assistance to farmers and other land users.

Teaching in colleges, universities, and technical schools.

Management of production, sales, service, and distribution of fertilizers, soil amendments, soil inoculants, seeds, etc., also of large-scale plantations, particularly in the tropics.

Other:

(*a*) Appraisal of soil productivity and rural land evaluation.

(*b*) Writing along pertinent technical lines, usually in connection with other functions.

(*c*) Crop estimates and appraisal of crop damage.

Soil Science

The soil scientist is primarily a research worker in field and laboratory, a teacher in colleges, universities and technical schools, an advisor in soil use and manipulation for construction, or an advisor in rural land use and management.

He is concerned with the fundamental principles of soil origin, distribution, composition, chemical properties, behaviour, and their application to individual soil management practice, crop production, farming systems and to those community enterprises that influence the soil or limit the alternative uses of soil.

Fields of Specialization

Soil Fertility and Management

Deals with the application of the principles of agronomy and soil chemistry as developed by scientific experiments and field studies, to the planning of crop rotations, soil management practices as strip cropping, contour ploughing, and land use on the farm unit, reforestation, as these relate to the conservation of soil and water. Related fields include agronomy, agricultural engineering, soil fertility and management, farm management, and soil classification.

Soil Genesis, Classification and Mapping

Studies by means of field trips, laboratory examination, and controlled experimentation, soil morphology, genesis (processes of soil formation), classification and productivity; and develops and carries out programmes of classifying and mapping soils. He evaluates the response of various soil types to management practices, and the adaptability of various crops to different soils.

Related fields include all soil specialities, crop production, geology, plant ecology, geography, and agricultural economics (production and farm management).

Soil Chemistry and Mineralogy

The application of principles of chemistry, mineralogy and agronomy to the problems of soil classification, formation, and composition; and soil problems encountered in crop production and soil management. Related fields include soil physics, soil microbiology, soil fertility, soil classification, geology, and plant physiology.

* Reproduced from *Journal of the American Society of Agronomy*, Vol. 37, pp. 668-670, 1945.

Soil Microbiology

The application of the principles and methods of microbiology and chemistry to: the studies of microbiological processes; the solving of problems which affect crop production, such as decomposition of organic matter by action of bacteria and fungi, and nitrogen fixation; soil fertility and management; soil and water conservation; soil genesis, morphology and classification; and the production and use of soil inoculants. Related fields include taxonomy of bacteria, physiology of bacteria, mycology, plant chemistry, soil chemistry, biological chemistry, soil fertility and management, soil physics, soil genesis, morphology and classification and crop production.

Soil Physics and Mechanics

The application of the methods and principles of physics to (*a*) solution of soil problems encountered in crop production, soil classification, drainage, and irrigation practices, and soil and water conservation and use; and (*b*) problems of soil stabilization and drainage for use as foundations for roads, dams, buildings, and other structures. Related fields include soil chemistry, mathematics, mechanical and civil engineering, soil classification, physics, and geology.

Soil Technology

The application of the principles and methods of soil science, agricultural engineering and associated fields to the development of effective practices in: (*a*) irrigation and drainage, (*b*) tillage, (*c*) runoff and erosion control techniques and structures; related fields include soil chemistry, soil physics, soil fertility, soil classification and agricultural engineering.

Other Specialities

There are several other specialities in soil science which, although important, do not include many individuals at present. In these specialized fields scientists have focussed their attention on particular problems or areas such as tropical soils, forest soils, farm planning, and soil productivity appraisal.

AVERAGE WEIGHT OF A BUNCH OF BANANAS

How much does a bunch of bananas weigh?

This question has long troubled Government research workers who have made studies relating to bananas. Formerly only infrequent and rough estimates of the weight of banana bunches were available for a few of the producing countries. Consequently, there was little uniformity in the factors used by Government research agencies for converting bunches into pounds.

Now that shipping weights are reported on import entry documents, however, it is possible to determine with a reasonable degree of accuracy the weight of the bunches imported into the United States.

During the first seven months of 1945 bananas entering the United States ranged in weight from 22 to 62 pounds per bunch (stem), depending on the country of origin. Guatemala, Honduras, Panama, and Costa Rica shipped the largest bunches, and Cuba, British Honduras, and Haiti the smallest. The average weight of bunches from all countries supplying the United States has risen from 46.6 pounds in 1943 to 50 pounds in 1945 (January-July). Inasmuch as Honduras and Guatemala are regaining their prewar position among the leading sources of this country's supply, it appears likely that the average weight of banana bunches will continue

Bananas, green or ripe: United States general imports, by source, and average weight per bunch, 1943, 1944, and January-July, 1945

Country	Bunches			Weight per bunch (pounds)		
	1943	1944	1945, Jan.-July	1943	1944	1945, Jan.-July
Mexico	7,852,627	6,096,752	3,629,162	34.6	33.1	36.1
Guatemala	2,739,559	4,397,298	4,938,483	59.9	62.3	61.8
Honduras	6,007,269	10,605,765	8,490,414	57.4	59.3	60.2
British Honduras	32,786	190,891	110,317	47.0	27.8	24.9
Nicaragua	—	1,006	28,217	—	29.8	33.2
Costa Rica	2,731,150	2,073,570	1,111,991	63.8	57.5	56.4
Panama	841,128	1,138,282	630,396	69.0	60.2	58.0
Canal Zone	43,395	30,782	404,841	70.0	46.6	59.0
Colombia	—	422,561	718,925	—	50.5	35.6
Ecuador	79,900	—	—	56.6	—	—
Bahamas	4,948	—	—	30.0	—	—
Cuba	2,566,874	2,572,736	1,458,734	27.4	22.5	22.2
Haiti	957,592	3,395,415	2,155,000	31.0	29.8	30.2
Dominican Republic	754,737	442,097	411,047	32.8	39.9	39.9
Jamaica	69,954	159,201	48,017	34.9	35.6	35.0
French West Indies	51,170	159,643	499,637	50.3	34.2	31.0
Total and average	24,729,089	31,685,999	24,635,181	46.6	47.6	50.0

Source: Official statistics of the U.S. Department of Commerce.

to rise. Considerable variation in weight per bunch occurs from year to year as a result of the weather and plant diseases. This variation was intensified during war years as many inferior bananas on immature and small bunches were marketed. Now that shipping space is available and supplies of bananas are increasing the tendency will be for better grades and larger bunches to be marketed in the chief producing countries.

The table shows United States imports and average weights of bunches from all countries for 1943, 1944, and the first seven months of 1945. During 1943 and 1944 imports were less than half of the prewar average; they will apparently reach more than three-fourths of that average by the end of 1945.—(Issued by *U.S. Tariff Commission*, October, 1945.)

CHEMICAL NOTES

(Compiled by the College Department of Chemistry and Soil Science)

Lack of Phosphate Main Cause of Low Soil Fertility in Some Australian Sugar-Cane Soils

SOIL analyses and farm fertility trials in the South Kalkie area of Queensland, Australia, indicated some thirteen years ago that the soils were deficient in phosphate but reasonably well supplied with potash. So low was the phosphate status of the land that, even in recent years, a first planting of cane after felling and clearing the forest was a complete failure unless fertilised with superphosphate. Organic matter in the soil is low. One fertility trial in this area over a period of three crops showed increases of 16.4 tons per acre to sulphate of ammonia, 12.9 tons per acre to superphosphate and 9.4 tons per acre to potash. In this case, the grower was advised to use Sugar Bureau No. 2 mixtures containing 12.5 per cent. phosphoric acid and 14.5 per cent. of potash. Other trials gave no results from potash applications but very good crop increases from superphosphate and sulphate of ammonia.

The growers in this area were in the habit of using, in pre-war times, fertilizer mixtures rich in phosphoric acid and low in potash. The fertility level of the soil was such that these mixtures were sufficient to supply the requirements of average to good crops.

The phosphate ration allowed during the war to this area, however, was below requirements. Superphosphate was in very short supply and, as meatworks products came into greater demand for stock feeding, the phosphate position tended to deteriorate. Before long the crops on these soils were noted to be heavily infected with brown stripe disease. This infection is caused by a fungus but its particular significance in this case arises from the fact that brown stripe disease is always most severe in varieties growing in soils of low fertility. The brown stripe is a symptom of potash or phosphate deficiency, or both. The brown stripe was so widespread and crops so uniformly poor when compared with pre-war production that it was decided to initiate a fertility survey on this South Kalkie area.—(*Australian Sug. Journ.*, Vol. 37, No. , p.165).

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Candlenut Oil

ONE of the less well-known drying oils that have been used in the manufacture of paints and varnishes is candlenut oil. This oil is obtained from the seeds of a tree which occurs in the Philippine Islands, India, Malaya, Australia, and Java. Its cultivation has been tried in Florida, Brazil and the West Indies. This oil has been employed from time to time in the United States as a paint and varnish oil when there has been a shortage of linseed oil or when the price of the latter oil has been sufficiently high to make the use of candlenut oil remunerative. The great difficulty experienced in the use of candlenuts as a source of a drying oil is the fact that it is not easy to decorticate them as the kernels adhere strongly to the shells. Candlenut oil compares as regards drying properties fairly favourably with linseed oil. It is used locally in paints and varnishes in the Philippine Islands, Java and elsewhere.—(*Chemistry and Industry* No. 37, 1945).

NOTE BOOK OF TROPICAL AGRICULTURE

Wood, R. Cecil (1945). *A note book of tropical agriculture.* 3rd ed., *iv* + 147 pp; Trinidad: Imperial College of Tropical Agriculture. Price 10*s.* 6*d.*

The third edition of this popular little book has just been issued. Its contents do not differ much from the two previous editions except for a few alterations and for the section on soils which has been revised. The contents cover many aspects of tropical agriculture which will be useful to planters and agricultural workers generally. Among the various subjects dealt with may be mentioned the weights and measures of different countries, useful instructions for mensuration and surveying, the construction of buildings and roads and the use of agricultural machinery. This is followed by many facts and figures on tropical crops and on manures, foods and feeding, and livestock.

The book which is priced at 10*s.* 6*d.* may be obtained on application to the Editor, Imperial College of Tropical Agriculture, Trinidad, B.W.I.

The Editor is prepared to consider signed articles for publication in *Tropical Agriculture.* Such articles should normally vary between 1,000 to 6,000 words and may be illustrated if desired.